memorandum

Environment and Resources

55 Wheeler Street, Cambridge, MA ◆ Tel: 617 492-7100 ◆ www.abtassociates.com

Abt Associates Inc.

Date	April 20, 2011
To	Rebecca Roose, Ashley Allen, and Jason Berner, U.S. Environmental Protection Agency
From	Jocelyn Sedlet and Elena Besedin, Abt Associates
Subject	Environmental Justice Phase II Literature Review

We conducted a literature review to inform an environmental justice (EJ) analysis of the proposed post-construction stormwater rule. We searched peer reviewed papers, government reports, published surveys, and government websites, identifying over 100 potentially relevant sources.[1]

An outline of the topics to be covered in the literature review was sent to EPA in a previous memo on March 17, 2011. These topics were to be covered in two phases of the literature review. Phase I was discussed in a previous memo. Phase I topics included review of information relevant to how, if at all, the rule will be implemented differently in EJ communities, the barriers to implementation of low impact development (LID) in EJ communities, and factors that affect how some benefits are distributed to EJ groups, including benefits from green jobs and benefits to recreation due to improved air and water quality.

In Phase II of the literature review, we looked for information on characteristics of subpopulations that may influence the benefits they receive as a result of the post-construction stormwater rule and/or the costs they incur relative to other subpopulations. Because the post-construction stormwater rule is only in the proposal stage, we cannot look for literature specifically on this rule. Instead, because it is expected that the rule will be implemented via LID procedures, we used LID as a proxy for the rule and designed our search relating to the benefits of the rule to focus on LID. In particular, we relied on keyword combinations such as "green infrastructure" and "low impact development" in our searches.

Most studies on LID do not specifically consider minority or low-income populations. However, where possible we tried to combine information in the studies with relevant information about the subpopulations to suggest possible reasonable inferences, as we describe below.

Each of the following sections focuses on a particular characteristic or set of characteristics that may differ across EJ subpopulations and thus have important implications for one or more components of an EJ analysis. Section 1 examines possible differences among subpopulations in drinking water consumption patterns and in the quality of water consumed. Section 2 focuses on property values. Section 3 considers factors affecting the benefits of reduced flooding. Section 4 considers factors affecting air quality benefits. Section 5 focuses on factors affecting the benefits of urban heat island mitigation. Section 6 discusses factors affecting the impact of stormwater utility fees and potential changes in fees resulting from the rule. Section 7 discusses factors affecting off-site mitigation and credits; Section 8 focuses on factors affecting benefits from increased groundwater recharge, and Section 9 addresses factors affecting the benefits of increased urban food security. In some sections, we offer

[1] Databases searched include Google and GoogleScholar, which returned articles from PubMed, Elsevier, and the National Institute of Health, among others. We also searched Census databases and municipality websites.

recommendations on how existing disproportionate impacts or potential disproportionate impacts resulting from the rule to EJ communities may be mitigated through the rule.

1 Drinking Water Consumption

The benefits of improvements in drinking water quality resulting from the post-construction rule will be distributed to all communities within a watershed that obtain drinking water from waterbodies affected by the rule. The literature review examined water consumption issues that could affect whether EJ communities benefit disproportionately as a result of the rule, or, alternatively, bear a disproportionate share of the costs of the rule.

1.1 Drinking Water Consumption Patterns

Several studies suggested that income can affect the demand for municipal water. Using a multiple regression model to estimate the effect of price, income, and household density on quantity of municipal water demanded, Foster Jr and Beattie (1979) find income to be a significant predictor of demand.

Espey et al (1997) estimate price elasticity of demand for water in residential areas. Their findings indicate that income influences price elasticity. Under each model estimate, income is negatively correlated with price elasticity, suggesting that higher incomes are associated with lower price elasticities. While this suggests that consumer surplus for low-income households is less than for high-income households at any given market equilibrium price, the benefit of a *change* in price (i.e., a shift in the supply curve), measured as change in consumer surplus, for low-income households relative to the benefit for high-income households is unclear.

We found only one study (Griffin and Chang 1991) that considered the effect of race, and that study focused only on the Hispanic subpopulation. These authors estimate a demand model for water, modeling average per capita water consumption in a community as a function of price, average income, percent Hispanic in the community, climate, and precipitation. The authors find that income is a significant predictor of average per capita water consumption. Percent Hispanic is associated with a decline in per capita water consumption, although the authors state that other studies have suggested this negative relationship is due to a larger number of people in Hispanic households (Murdock et al. 1986, as cited in Griffin and Chang 1991).

These data indicate that income and price affect the amount of water consumed. If drinking water treatment costs decrease as a result of the rule, there are potential benefits to low-income communities, who may be able to afford more water as a result. However, as discussed above, benefits depend on consumer surplus. Effects of the rule on consumer surplus is unknown.

1.2 Characteristics of Drinking Water Consumed

Several studies report evidence that low-income groups may be exposed to more polluted drinking water. Evans and Kantrowitz (2002) summarize these studies, which identify several instances in which low-income or minority populations were found to have a disproportionately large incidence of contaminated drinking water supplies (Calderon et al. 1993; Cieselski et al. 1991, both as cited in Evans and Kantrowitz 2002).

2 Property Values

[redacted] We examined literature that addressed the impact of increased property values on low-income and minority populations to evaluate the possibility that the rule will have disproportionate effects on EJ communities. Increases in property values could have a negative effect on EJ communities if the stormwater rule results in “environmental gentrification,” described in the following section.

2.1 Environmental Gentrification

Environmental gentrification is a process in which property value increases resulting from environmental improvements cause low-income individuals to move from the neighborhood due to higher costs of living. Gentrification can occur either over time, as homes are slowly sold and the area is repopulated with more affluent residents, or immediately, when redevelopment occurs and low-income families cannot afford higher rents or mortgages (CDC 2009). (Banzhaf 2010) describes environmental gentrification in terms of willingness to pay (WTP) for environmental amenities, noting that low-income individuals do not have the income to live in cleaner neighborhoods and so have a lower WTP for a clean environment, although they do not necessarily value a clean environment any less than higher income individuals. Renters may be negatively affected by increased property values because "the increase in these rents may more than offset the direct benefit they receive from the environmental improvement" (Banzhaf 2010).

Banzhaf and McCormick (2007) examine the impact on renters and homeowners of the cleanup of areas considered locally undesirable land uses (LULUs), suggesting that environmental gentrification may be caused by property value increases. Homeowners may also be negatively affected by increased property values, however, if their property taxes also increase. The authors suggest that cleanup may lead to inefficient outcomes depending on whether property owners value the cleaner environment (Banzhaf and McCormick 2007).

2.2 Differences in Homeownership Rates

Current homeownership data on the national and state levels will be useful in determining the effect of an increase in property values on minority groups and will inform research regarding existing disproportionate impacts on EJ communities due to differential homeownership rates. Homeownership and other socioeconomic data is available from several sources, including the U.S. Census' American FactFinder Tool and City-Data.com, which provides detailed demographic data for cities throughout the U.S. (City-Data 2011; U.S. Census Bureau 2000). Census data provides homeownership data by race and state as well as by metropolitan or suburban area.[2] These data may also allow for a more quantitative analysis of this effect using GIS tools.

Several sources indicate differences among subgroups in homeownership rates. Retsinas and E.S. Belsky (2002) find that homeownership rates among minority and low-income subgroups are lower than the national average. Di and Liu (2007) examine homeownership in a sample of 5,000 families over five-year intervals, finding average income over a five-year period to be a significant predictor of homeownership at the end of that time period. Banzhaf (2010) reports that 83% of people below the poverty line rent rather than own their homes.

Data from the U.S. Census Bureau indicate that homeownership rates vary by race. The overall homeownership rate in the U.S. in 2000 was 66%. The same survey reported that 72% of whites owned their homes, while only 46% of Hispanics and Blacks, 56% of Alaska Natives and Native Americans, and 53% of Asians owned their homes in 2000 (U.S. Census Bureau 2004).

Since homeowners benefit disproportionately from increased property values, as discussed above, these discrepancies in homeownership rates imply that these low-income and minority subgroups may benefit less from increased property values than other subgroups.

One study that examined housing decisions from 1984 to 1992 found that lower income and minority families generally take longer to achieve homeownership and are less likely to maintain homeownership (Boehm and Schlottmann 2004).

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[2] Available at http://www.census.gov/hhes/www/housing/hvs/annual10/ann10ind.html

2.3 Recommendations for Increasing Homeownership in EJ Communities and Preventing Gentrification

As briefly discussed in the Phase I literature review, several sources discuss ways to mitigate or prevent environmental gentrification. In a review of the benefits of green infrastructure, Schilling (undated) discusses the possibility of gentrification in the implementation of green infrastructure projects and states that "it is essential to deliberately incorporate programs into greening plans that ensure current residents can capture the increased value and that existing renters will find some support in their desire to remain in place" (undated). The Community Land Trust, for example, was created as part of the ENLACE Caño Martín Peña Project, a green infrastructure project implemented in Puerto Rico. The Community Land Trust prevents gentrification by investing increases in land value into the community and ensuring that housing is affordable (USEPA 2010a).

Some literature provides recommendations for encouraging low-income homeownership. Olsen (2007) addresses low homeownership rates among low-income populations through subsidies for first-time homebuyers or tax credits for low-income homeownership, in addition to tax credits for rentals. Herbert and Tsen (2007) examines the effectiveness of providing downpayment assistance to minority and low-income families in increasing homeownership among these subgroups. The authors find that homeownership is dependent upon liquid assets and that downpayment assistance can significantly affect homeownership rates (Herbert and Tsen 2007).

3 Factors Affecting Benefits from Reduced Flooding

Studies show that EJ communities are less prepared for and more significantly affected by natural disasters (Cutter et al. 2000; Fothergill and Peek 2004; Zahran et al. 2008). One of the benefits of the post-construction stormwater rule is expected to be reduced risk of flooding due to increased infiltration (CNT and American Rivers 2010). If EJ communities are more likely to be located in areas at higher risk for flooding, then the benefits of the post-construction stormwater rule resulting from reduced risk of flooding may accrue disproportionately to low-income or minority populations.

3.1 Natural Disaster Preparedness

Several studies examined differential impacts of natural disasters on minority and low-income communities. Fothergill and Peek (2004) summarize the available literature regarding the link between natural disasters and disadvantaged communities. They find that social exclusion, location, type of residence, and building construction causes these populations to be more susceptible to damages associated with natural disasters. This study reports that low-income groups are often less prepared for natural disasters, and that increasing income generally leads to better preparation (Turner et al. 1986, as cited in Fothergill and Peek 2004). Cutter et al (2000) supports findings that low-income and minority populations are more vulnerable to disasters.

Many studies find that low-income individuals are less likely to be covered under a flood insurance policy, as evidenced by positive income elasticity of demand for flood insurance and a positive correlation between average income and flood coverage across populations (Browne and Hoyt 2000; Landry and Jahan-Parvar 2010; Maantay and Maroko 2009; Treby et al. 2006). Browne and Hoyt (2000) estimate that a 1% increase in average per capita income is associated with a 1.4% increase in the number of policies per 1,000 people and a 1.5% increase in the total value insured per 1,000 people. Landry and Jahan-Parvar (2010) find that flood insurance is a normal good, which indicates that an increase in income is associated with an increase in demand for the good. The study estimates income elasticity to be 0.57 (Landry and Jahan-Parvar 2010). Maantay and Maroko (2009) and Treby (2006) support the finding that low-income groups are less likely to obtain flood insurance.

Several studies do, however, state that populations of lower socioeconomic status are aware of and may even have greater perception of risk than those of higher socioeconomic status (Flynn et al. 1994; Vaughan 1995, both as cited in Fothergill and Peek 2004).

3.2 Differential Impacts of Natural Disasters on EJ Communities

Fothergill and Peek (2004) examines the stages of a natural disaster, including warning communication and response, physical impacts, psychological impacts, emergency response, recovery, and reconstruction. In each stage, the study summarizes the relevant literature describing the ways in which subgroups of low socioeconomic status are particularly vulnerable. The literature suggests that these groups do not always receive warnings, and even when they do, are less likely to understand or believe them (Panel on the Public Policy Implications of Earthquake Prediction 1975, as cited in Fothergill and Peek 2004), due to language and cultural barriers, among other reasons (Aguirre 1988, as cited in Fothergill and Peek 2004). Literature described in Fothergill and Peek (2004) provides evidence that people of low socioeconomic status are generally more vulnerable to natural disasters. Another study (Zahran et al. 2008) specifically addresses the impact of flooding on EJ communities, examining casualties resulting from flood events in 25 counties in Texas. The study finds a larger percentage of flood-caused death and injury in areas with a disproportionate number of minority or low-income individuals (Zahran et al. 2008).

3.3 Location in Flood Zones

We found minimal and inconsistent evidence regarding the demographic characteristics of populations in flood-prone areas. Maantay and Maroko (2009) examine the relationship between race and flood-prone areas in the five boroughs of New York City, finding greater percentages of minority populations than expected in flood-prone regions of three of the five boroughs, while the percentages of white populations were higher than expected in the other two boroughs. On the other hand, the authors report that there is no disproportionate number of minorities in 100-year flood plains (Maantay and Maroko 2009). Zahran et al (2008) reports that low-income and minority groups are more susceptible to disasters because "they are more likely to reside in older, poorer, high-density, segregated, and disaster-prone areas" (Zahran et al. 2008).[3]

One study found that rising flood premiums for those living in flood-prone areas is a concern in the UK (Priest et al. 2005). If low-income groups do disproportionately live in more flood-prone areas, they either may have to buy high-premium flood insurance or suffer disproportionately high flood damages. The literature suggests the latter, given that low-income groups are less likely to buy flood insurance (Browne and Hoyt 2000; Landry and Jahan-Parvar 2010; Maantay and Maroko 2009; Treby et al. 2006).

4 Factors Affecting Air Quality Benefits

[redacted] increased vegetation used in stormwater management will remove some air pollutants, thereby reducing their ambient concentrations.

Several studies find that low-income and minority populations are more likely to reside in densely concentrated urban areas (Chau 2009; Zahran et al. 2008). Because air quality benefits are likely to be concentrated in these areas, it is possible that these populations will benefit disproportionately from air quality improvements. Numerous studies have found significant relationships between ambient

[3] Author cites several sources (Bolin 1986; Bolin and Bolton 1986; Charles 2003; Cochrane 1975; Foley 1980; Logan and Molotch 1987; Massey and Denton 1993; Peacock et al. 2006; Peacock and Girard 1997; Phillips 1993; Phillips and Ephraim 1992).

concentrations of criteria air pollutants, such as particulate matter (PM) and ozone, and premature mortality and various types of morbidity.[4]

While benefits are expected to accrue to all populations living within an affected airshed, greater benefits may accrue to EJ communities in particular due to their higher baseline incidence rates of those adverse health effects associated with various air pollutants.

Most air pollution epidemiology studies estimate concentration-response functions between an air pollutant and a health effect that are log-linear in form. This means that the change in incidence of the health effect in the population resulting from a change in the ambient concentration of the pollutant depends on the baseline incidence rate (the rate of the health effect under baseline conditions). As the baseline incidence rate increases, the impact of a given change in ambient pollutant concentration increases as well. For example, if subpopulation A's baseline mortality rate is twice that of subpopulation B, the same reduction in ambient particulate matter concentration will result in a reduction in mortality rate for subpopulation A that is twice the reduction experienced by subpopulation B, all else equal. This is explained in Post et al. (2011) describing a method appropriate for EJ analyses of national air pollution rules.

Several resources examined in the literature review provide evidence of existing disproportionate effects on low-income and minority populations due to greater exposure to air polluition (Banzhaf and McCormick 2007; Bullard 1993; Bullard undated; Carson et al. 1997; Ostro et al. 2001; Ponce et al. 2005). Carson et al (1997) examines emissions of seven pollutants in each of the 50 U.S. states, finding air pollution to be negatively correlated with per capita income. Bullard (1993) writes on the causes and impacts of these disproportionate impacts, stating that environmental wastes and facilities disproportionately affect EJ communities.

Ostro et al (2001) evaluate African American children in Los Angeles in order to determine whether there is a link between increasing rates of asthma among this population and environmental factors. The authors find a correlation between asthma rates and exposure to particulate matter and nitrogen oxides. Ponce et al (2005) examine the exposure of pregnant women to traffic pollution in Los Angeles, finding that populations of low socioeconomic status were disproportionately affected by air pollution during the winter (Ponce et al. 2005).

5 Factors Affecting Urban Heat Island Mitigation Benefits

[redacted] Because low-income and minority populations are often located in densely concentrated areas (Chau 2009; Zahran et al. 2008), it is possible that these populations will disproportionately benefit from UHI mitigation. Mitigation of UHI will result in less need for energy for cooling. It is possible that low-income groups spend a larger portion of their income on energy, indicating that this group would benefit disproportionately from lower energy needs. Therefore, energy consumption patterns were examined to investigate the possibility of disproportionate benefits accruing to these communities. The literature review also identified sources that address the susceptibility of low-income and minority populations to heat-related illness and mortality, a second potential source of disproportionate impact.

5.1 Energy Consumption Patterns

Several studies measure energy use as a function of demographic variables, including income and race (Beierlein et al. 1981; Branch 1993; Hirst et al. 1982; Maddala et al. 1997; Poyer and Williams 1993;

[4] For an extensive live of relevant studies, see the most recent Integrated Science Assessment for PM, available online at http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_2007_isa.html and the most recent Criteria Document for ozone, available online at: http://www.epa.gov/ttn/naaqs/standards/ozone/s_o3_cr_cd.html

Shin 1985). Hirst et al (1982) regressed energy use on household income, finding that the income elasticity for household energy use is 0.08. A low elasticity value indicates that energy use is not very responsive to income changes. However, income elasticity of demand for electricity, estimated to be 0.15, is larger than for total energy, suggesting that electricity use is more sensitive to changes in income (Hirst et al. 1982). Beierlein et al (1981), however, finds income elasticities of demand for electricity ranging from -0.005 to .0150, depending upon the model used. The author reports that income elasticity of demand values were generally smaller than those found in previous studies, and that these values are insignificant (Beierlein et al. 1981). Income elasticity of demand indicates changes in energy consumption as a result of marginal changes in income; however, this does not provide enough information to determine how a shift in the demand curve to the left (due to lower energy demand) would affect consumer surplus and therefore benefits.

Research also indicates that income and price elasticities for total energy and electricity consumption vary by race. A study measuring price and income elasticities of demand for electricity by race subgroup found that while overall, energy use is inelastic to changes in price, Blacks show the highest price elasticity relative to Hispanic and white populations (Poyer and Williams 1993). Income elasticities varied among subgroups, with Hispanics showing the highest long-run elasticities for both electricity and energy use as well as for short-run electricity consumption. Blacks have the lowest income elasticity for short- and long-run energy consumption, while their short- and long-run elasticities for electricity fall between Hispanics and whites (Poyer and Williams 1993).

Results from Garbacz (1983) support findings that energy consumption differs between whites and nonwhites. Garbacz (1983) estimates appliance stock as a function of race, finding that nonwhites have an appliance stock index value 0.166 lower than whites, a small difference. Appliance stock index was directly related to electricity consumption through a regression equation. The author finds that a 1 unit increase in the appliance stock index is associated with a 1.3% increase in electricity consumption (Garbacz 1983). It follows that nonwhites may have slightly lower electricity consumption than whites.

Electricity consumption also depends upon whether the household uses air-conditioning. Results of one study indicate that households with air conditioning use 0.17% more electricity per cooling day than those that do not have air-conditioning (Branch 1993). Scott (2006) discusses the lack of air-conditioning among low-income populations in New York City. Low-income or minority households that do not use air conditioning will likely not benefit from lower energy spending associated with reduced use of air conditioning; however, disproportionate benefits may accrue to EJ communities as a result of reduced heat-related mortality, described in the following section.

5.2 Factors Affecting Heat-Related Mortality

Chestnut et al. (1998) examines the causes of hot-weather related mortality in 44 metropolitan areas in the United States. The authors report that standard of living, access to air conditioning, and quality of housing are all correlated with heat-related mortality (Chestnut et al. 1998). Anderson and Bell (2009) examines the effect of various community characteristics on heat- and cold-related mortality. The authors report that urbanicity, socioeconomic conditions, age, and access to air conditioning are primary contributors to mortality vulnerability (Anderson and Bell 2009).

Some studies suggest that heat-related mortality is linked to a lack of air conditioning. During the 1995 Chicago heat wave, for example, the majority of deaths occurred among those who did not have access to or could not afford air-conditioning (Changnon and Kunkel 1996). In a national study of heat-related deaths, Rogot et al (1992) found that people with access to central air-conditioning were 42% less likely to die from heat-related illnesses than those who do not have air-conditioning. Scott (2006) notes that in New York City, many low-income individuals do not have air-conditioning; this may put them at a greater risk for heat-related mortality.

Several studies find that low-income groups are more susceptible to heat-related illness and mortality due to greater exposure (Johnson and Wilson 2009; O'Neill et al. 2003; Schuman 1972). Johnson and Wilson (2009) linked heat-related mortality to low-income groups, finding that the spatial distribution of heat-related deaths was aligned with low-income populations. The authors suggest that income is an indicator for vulnerability to extreme heat (Johnson and Wilson 2009). Schuman (1972) finds higher heat-related mortality among low-income groups, and O'Neill et al (2003) reports that low socioeconomic status is associated with higher susceptibility to temperature-related death.

Several studies found differences in heat-related illness and death based on race. Schuman (1972) investigated heat-related mortality during heat waves in New York and St. Louis, finding differences in risk based on race and gender. In New York, white women were at greater risk for heat-related death, while in St. Louis, nonwhite men and women were at higher risk. During a 1980 heat wave in Memphis, Tennessee, the majority of 83 deaths were low-income, elderly, black residents. All excess deaths occurred among elderly people (Applegate et al. 1981). Macey and Schneider (1993) study temperature-related deaths in people 60 years and older, finding that among the elderly people studied, a disproportionately larger number of heat- or cold-related deaths occurred among minorities and people living in rural areas. Ramlow and Kuller (1990), however, find no significant difference in heat-related deaths between whites and non-whites during a heat-wave in Allegheny County, Pennsylvania in 1988. Excess deaths were, however, related to age (Ramlow and Kuller 1990).

One study (Harlan et al. 2008) also found that minorities are more susceptible to heat-related illness due to location. Harlan et al (2008) examined spatial patterns of temperature and geographic distribution of white and Latino subgroups, finding that Latinos were more often located in more climatically stressed areas with less vegetation than higher-income whites. This suggests a disproportionate effect associated with the spatial distribution of different population subgroups. [redacted]

5.3 Vulnerability to UHI caused by Outdoor Employment

Few sources discussed employment of minority or low-income populations in the outdoor employment sector. The literature that is available discusses gender differences in outdoor employment but does not discuss race or income differences in these jobs. Many articles discuss lower participation rates in outdoor activities among minorities (see Phase I literature review). One article suggests that the lack of participation in outdoor recreation "due to economic, cultural, and discrimination-related barriers" may be keeping some minorities from outdoor-oriented careers" (Kuhns et al. 2004). No scholarly articles were found to discuss the relationship between outdoor employment and race or income.

6 Factors Affecting Impacts of Stormwater Utility Fees

Stormwater utility fees are generally based on the number of Equivalent Residential Units (ERUs) contained on a property, defined in terms of the average square footage of impervious surface on a residential property. Based on the literature reviewed, including various municipality websites, stormwater surveys, and stormwater funding guidance literature, fees are generally charged on a monthly basis and range from $2-10 per month (American Rivers et al. 2008; Athens-Clarke County Unified Government 2011; Bay County 2007; Black & Veatch 2010; Bluegrass Pride 2008; City & Community of Arvada 2011; City of Bend 2007; City of Orlando 2011; City of Richmond Department of Public Utilities 2010; City of The Colony 2011; Douglas County 2005; Ferrance-Wu 2010; Town of Fishers 2011).

6.1 Existing Disproportionate Impact due to Stormwater Utility Fees

Many municipalities use stormwater utilities to finance stormwater management. The New Hampshire Department of Environmental Services estimates the number of stormwater utilities nationwide at around 1,200 (New Hampshire DES 2008). In a survey of stormwater utilities, 80% of utilities say that their major source of revenue is stormwater user fees, and 68% fund capital needs through stormwater user fees. The survey addresses how fees are calculated: 55% base stormwater fees on the amount of impervious surface (Black & Veatch 2010).

Studies suggest that the cost of stormwater management may currently cause disproportionate costs to be incurred by low-income populations. American Rivers et al (2008) states that an increase in monthly costs for low-income residents has been shown to be burdensome in Detroit, where low-income residents could not afford the cost increase. Stormwater utility fees that are levied based on the percentage of impervious surface can be greater for urban cities, where low-income/minority populations are often concentrated (Chau 2009). During a Chesapeake Bay Listening Session held in 2010, one participant noted that stormwater fees are a problem in Baltimore, where per-capita income is low but ”the amount of money the city needs to rebuild their stormwater system is staggering at roughly $100 needed/household” (USEPA 2010b). Sierra Club (2009) and (USEPA 2010c) also support the finding that the cost of stormwater management is higher in urban areas, although this does not necessarily translate to higher stormwater fees, as this depends on how stormwater management costs are funded.

6.2 Effect of the Stormwater Rule on Utility Fees

No sources reviewed in the literature search provided information regarding how stormwater utility fees might change as a result of the rule or how, if at all, stormwater utility fees change with increased LID implementation. A review of selected stormwater utilities suggests that many utilities charge fees based on ERUs, but that residential units are often charged a flat fee per month. This fee is based on a value of impervious surface expected for the typical residential property (ERU). Some utilities, however, charge utility fees based on various tiered ranges of impervious surface (Ferrance-Wu 2010). These impervious surface brackets may impact the ability of households to reduce their stormwater utility fees, although the literature does not provide evidence on how households could take advantage of this tiered system to reduce their own stormwater utility fees. For municipalities which charge flat fees for residential properties, however, there may be incentive for individual households to implement best management practices (BMPs) if a credit system is put in place, further described in the Recommendations section below.

6.3 Recommendations

Chau (2009) states that one way to mitigate the disproportionate effect caused by stormwater utility fees is to charge fees based on total impervious area rather than percentage impervious area, which will reduce fees for low-income, minority, and indigenous populations located in more concentrated urban areas. Stormwater utility fees reviewed from a variety of municipalities, however, suggest that many utilities already levy fees based on the total amount of impervious surface located in a particular area (Athens-Clarke County Unified Government 2011; City & Community of Arvada 2011; City of Bend 2007; City of Orlando 2011; City of Richmond Department of Public Utilities 2010; City of The Colony 2011; Douglas County 2005; Ferrance-Wu 2010; Town of Fishers 2011).

Several studies also suggest the utilization of stormwater utility fee credits or discounts to reduce fees with the implementation of LID techniques. Carter and Fowler (2008) provides a method of using stormwater utility fee discounts to incentivize green infrastructure, suggesting that credits be offered for the installation of green roofs. USEPA (2009) discusses potential reductions in stormwater utility fees through the use of credits for implementation of BMPs and provides examples of utilities that currently offer stormwater credits for low impact development implementation. New Hampshire Department of Environmental Services also describes several examples of municipalities that offer credits for reduction in stormwater utility fees (New Hampshire DES 2008).

American Rivers et al (2008) supports fee discounts and credits as a way to encourage green infrastructure implementation. Residents are incentivized to make property changes that will reduce stormwater runoff, leading to lower costs for municipal stormwater utilities. Offering fee discounts allows residents to pay for stormwater utilities based on the amount of runoff the property generates, maintaining a fee-for-service program (American Rivers et al. 2008). Fee discounts should be based on the goal a municipality wants to achieve (i.e., reduction in imperviousness, increased on-site management, reduction in stormwater volume, or use of specific equipment). The report provides details on how to meet each of these goals through fee discount systems (American Rivers et al. 2008).

The report also acknowledges that utility fees may have consequences for low-income households that cannot afford an additional monthly charge and describes mechanisms developed to address these problems, including discounts, no-interest loans, and crisis vouchers. The report examines several case studies in which municipalities used stormwater utility fees to offset infrastructure costs (American Rivers et al. 2008).

Bluegrass Pride, a Kentucky non-profit that provides a handbook for municipal administrators detailing ways to implement green infrastructure, suggests that public education is an essential part of a stormwater utility. In order to ensure public confidence in the program and allow residents to understand the benefits of a stormwater utility, municipal stormwater management efforts must be visible or made known to residents (Bluegrass Pride 2008).

7 Factors Affecting Impacts of Off-Site Mitigation/Credits or Brownfield Redevelopment

[redacted] We reviewed studies that discuss impacts and provide examples of off-site mitigation in order to investigate the effect of this alternative on EJ communities. Recommendations are provided for off-site mitigation programs that encourage LID implementation in certain areas (i.e., urban cores).

7.1 Existing Disproportionate Impacts of Brownfields

As discussed in Phase I of the literature review, several sources suggest that brownfields may have an existing disproportionate impact on minority and low-income groups caused by the frequently close proximity of EJ communities (Council for Urban Economic Development 1999, as cited in Banzhaf and McCormick 2007; Heberle and Wernstedt 2005, as cited in Banzhaf and McCormick 2007; Twombly 1997, as cited in Bullard undated). One study finds that the majority of brownfields are located in urban areas near EJ communities (Twombly 1997, as cited in Bullard undated). Another study examined this disproportionate impact by comparing demographic characteristics of populations living within a one-mile radius of a large sample of brownfields to state averages, finding that brownfields were generally located in areas with a disproportionate number of low-income/minority individuals (Council for Urban Economic Development 1999, as cited in Banzhaf and McCormick 2007). Other studies support the finding that brownfields are disproportionately located in proximity to low-income and minority populations (Heberle and Wernstedt 2005, as cited in Banzhaf and McCormick 2007).

7.2 Impact of Off-Site Mitigation on EJ Communities

Off-site mitigation would allow developers to implement BMP projects where costs are lowest (AWRP undated). This does, however, create the possibility of pollution hot spots in low-income or minority neighborhoods (AWRP undated), a concern often associated with EJ communities, as described above. This will be relevant to the discussion of whether restrictions will be placed on the location or nature of off-site mitigation projects. This topic is addressed in the Recommendations section below.

A recent report describing the effects of implementing a stormwater rule in Washington, D.C. suggested that off-site mitigation would “produce a trend toward less stormwater retention in the more densely developed, more affluent downtown core and more stormwater retention in less developed and possibly less affluent communities” (AWRP undated). Little other information was found in the literature that describes how brownfield redevelopment would affect low-income or minority communities. The disproportionate impacts imposed on EJ communities by their proximity to hazardous brownfield sites, as described above, suggests that incentives for brownfield redevelopment could have disproportionately high benefits for EJ communities. One author, however, suggests that incentives for the reuse of brownfields may lead to more relaxed cleanup laws in order to encourage business development and economic growth (Engle 1997-1998).

7.3 Recommendations for Implementation of Off-Site Mitigation

Several sources offer recommendations for utilizing off-site mitigation or credit systems in stormwater management to encourage the use of LID in particular areas through off-site mitigation guidelines and financial incentives (AWRP undated; Bahuguna et al. 2009; Horner undated). These recommendations may provide ways in which the rule could offer off-site mitigation and provide incentives for BMP implementation in EJ communities or for brownfield redevelopment. The DC Off-Site Mitigation Program involves measuring on-site and off-site compliance by the volume of stormwater retained. Off-site mitigation projects must provide additional stormwater retention beyond the retention volume under existing conditions in the off-site location. Retention credits would be earned for off-site mitigation, to be used or sold by the owner (AWRP undated).

DC’s Off-Site Mitigation plan also suggests that the District offer assistance to developers by creating a list of off-site mitigation projects that can be implemented for retention credit (AWRP undated). This may be a potential channel through which EPA can encourage implementation of BMPs in EJ communities.

A report prepared for the Nicholas Institute for Environmental Policy Solutions in North Carolina provides cost incentives for LID implementation in downtown areas (Bahuguna et al. 2009). The report suggests creating an off-site mitigation program in which the city develops and maintains BMPs. Developers then fund these costs by buying stormwater credits for these off-site BMPs. The report also suggests that capital costs for BMPs in downtown areas be funded in part by the city through increased stormwater utility fees (Bahuguna et al. 2009). Based on literature reviewed in the above section, however, increasing stormwater fees in downtown urban areas has the potential to exacerbate environmental justice concerns if these areas have a disproportionately high number of low-income/minority individuals.

Some municipalities in North Carolina require Escrow accounts for the maintenance of BMPs, created by developers upon construction of the BMP and replenished by property owners as funds are used for operations and maintenance. A variation of this strategy would be to have the municipality be in charge of operations and maintenance using the money in this Escrow account (Bahuguna et al. 2009).

West Virginia’s National Pollutant Discharge Elimination System (NPDES) permit program allows for off-site mitigation, but specifies that off-site projects must involve retrofitting or redevelopment and must occur in the same watershed or sewershed. As in the recommendations detailed by the Nicholas Institute report above, the West Virginia permit program provides a list of areas for off-site BMP implementation (Horner undated).

8 Factors Affecting Benefits from Increased Groundwater Recharge

Increased groundwater recharge will occur with LID as impervious surface is replaced with pervious surfaces and greater infiltration occurs (CNT and American Rivers 2010). One study estimates that an area with 75% or greater impervious surface has only 15% infiltration of precipitation, while an area with no impervious surface results in infiltration of 35% of precipitation (Paul and Meyer 2001). Impervious surface is a primary cause of the lack of groundwater recharge (Finkenbine 2007). No information was found in the literature review regarding how EJ communities are affected by increased groundwater recharge. The impacts to particular population subgroups may be better understood by examining their use of private wells that tap directly into groundwater sources. U.S. Census data provide percentages of people whose primary source of water is private wells, but these data do not appear to be broken down by race or income (U.S. Census Bureau 2009).

9 Factors Affecting Benefits from Possible Increased Community Gardens

Several sources suggest that increased community gardens be a benefit of LID. Wolf (2011) links community gardens with increased food security. Livesley (undated) states that green infrastructure may lead to increased local food production, which can lower the cost of food for the communities engaging in such production. Whether EJ communities will disproportionately benefit from an increase in urban food security will depend on the extent to which they disproportionately develop and maintain community gardens.

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